Influence of Non-Traditional Feed Additives on the Quality of Horse Breeding Products

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Abstract

The article presents the results of a study of the influence of local non-traditional feed additives (Hongurin's and Sapropel's zeolite) on the milk productivity qualitative indicators of Marezhek breed mares in Yakutia. The experiments were conducted in Yakutsk at the farm "Eige" on horses of the Megezheksky breed. One control and two experimental groups of similar mares were collected. The average live weight of the mares was 450 kg. An organoleptic evaluation of mare's milk was carried out. There were found no differences between the samples. At the same time, it

should be noted that the use of Sapropel's zeolite feed additives in the diet of lactating mares did not reduce the taste of mare's milk. One lactating mare consumed 4,581.2 EFU (energetic feed unit). The amount of feed consumed during the experiment in different seasons was consistent with the norm. For the entire period of the experiment, the mares consumed 435.0 kg of digestible protein, 45812.0 MJ of exchange energy. When using Sapropel's zeolite feed additives in the diets of experimental mares, there was a tendency to a change in the vitamin composition of milk towards an increase in the concentration of vitamins A, C, B1, B2, B6 and B12. Comparing the indices of the experimental groups, the III experimental group contained more vitamin B1 by 3.03%, vitamin B2 - by 6.98%, vitamin B6 – by 3.03%, and vitamin B12 – by 7.41%.

Keywords: horse breeding; feeding; feed additives; productivity; analysis.

Introduction

Horse breeding is one of the traditional branches of the Republic of Sakha (Yakutia). Dairy horse breeding is developing, the production of Koumyss (in Yakut. Kymys) in the republic is in demand at any time of the year. It is known that in Yakutia, Koumyss is traditionally produced in large quantities in the summer for the Ysyakh holiday. Every year there is an increase in demand for local products, including Koumyss. The composition of Koumyss includes beneficial microbiota, macro- and microelements, and most important vitamins, while the product is considered useful and dietary. In dairy horse breeding, in addition to increasing the level of milk production, the implementation of various technologies for preserving the biological properties of products, as well as improving the productive and technological properties and increasing the vitamin component of dairy products are the tasks that are set for production and the scientific community of the republic (Gabysheva, 2016; Ivanovich et al., 2018; Nakada, Grigorev, 2019).

In the conditions of Yakutia, there is a shortage of macro- and microelements in plant-based feeds, which together with the harsh continental climate negatively affects the efficiency of animal husbandry. Therefore, to achieve full-fledged feeding, various premixes and feed additives are introduced into the main diet. The most effective feed additives in Yakutia include Suntar zeolite and sapropels of local lakes, the composition of which is rich in various minerals. The use of zeolite and sapropels in the feeding of farm animals improves the metabolism, physiological condition and economic efficiency of animal husbandry.

The lack of micro and macro elements in the soil and feed of Yakutia affects the health status and productivity of animals. The introduction of feed additives, premixes in the animal diets allows covering the deficit of minerals in feed. These measures in turn can increase the productivity of farm animals (Nikolaeva et al., 2015).

For the first time in the conditions of Yakutia, researches were conducted to study the effect of Zeolite-Sapropel feed additives on the milk production of Megezheksky mares. During the period of scientific and economic experiments, the influence of Zeolite-Sapropel feed additives on the milk production and physiological parameters of mares of the Megezheksky breed was established.

The efficiency of dairy horse breeding is determined by increasing the level of productivity of mares, improving the quality of dairy products.

The works of Adegbeye et al. (2019), Kaya-Karasu et al. (2018), Michalak et al. (2019), Neustädter et al. (2018), Warren (2017), and Zebeli et al. (2015) are devoted to studying the influence of various natural feed additives on milk production, physiology, and metabolism of mares. The basis for our research was the lack of data on the effect of feeding Zeolite-Sapropel feed additives on the quality indicators of horse breeding, in particular on the quality of milk of the Megezheksky breed mares.

Therefore, the aim of the research was to determine the effect of Zeolite-Sapropel feed additives on the milk productivity of the Megezheksky mares in the conditions of Central Yakutia.

Objectives of the research:

- Studying the effect of Zeolite-Sapropel feed additives on the organoleptic indicators of mare's milk quality;
- Studying the vitamin composition of mares' milk when feeding houses with Zeolite-Sapropel feed additives.

Methods

Horses with year-round grazing content not only survive, but can also give milk. But for this purpose it is necessary to provide horses with nutrients. The productivity of horses depends on the quantity and quality of pasture grass. During the long winter, negative temperatures are often observed, which fluctuates in the range of minus 40-48°C, with a lack of nutrients in the feed, this can severely deplete the horses. Therefore, horses are provided with insurance reserves of feed for one head of 5 quintals of hay.

This scientific work is based on the materials of our own research on the influence of zeolite and Zeolite-Sapropel feed additives on the milk productivity of mares of the megezhek breed and the production of Koumyss in Central Yakutia. The experiments were organized on mares of the Megezheksky breed in the conditions of the farm "Eige" in Yakutsk. The research was conducted during 2018. To conduct scientific and economic experiments, three groups of milking mares,

12 animals each, were selected on the basis of analogues. The average live weight of dairy mares was 450 kg. In accordance with the research program, the control group of milking mares received the main household diet, which is presented in table 1, and animals of the I and II experimental groups, in addition to the main household diet, received Zeolite-Sapropel feed additives once a day in the norm: zeolite 0.5 g per kg of body weight with 200 and 300 g of Sapropel, respectively.

The theoretical basis of these studies was the work of scientists on the problems of using natural mineral feed additives in the feeding of farm animals (Adegbeye et al., 2019; Michalak et al., 2019; Neustädter et al., 2019). In the process of conducting research, there were used methods that are generally accepted in animal husbandry: analytical, biochemical and statistical.

In the course of research, the effectiveness of such feeding was evaluated by indicators of milk productivity, production of commercial milk, physical and chemical indicators of milk and Koumyss, organoleptic indicators of milk, vitamin composition of milk and Koumyss.

Biochemical and organoleptic studies of mare's milk were carried out according to generally accepted methods in the laboratories of Yakutsk State Agricultural Academy and Northeast Federal University named after M.K. Ammosov.

The technology of keeping horses in the farm has its own characteristics, which arise from the natural and climatic conditions of the region, from the presence of hay and pasture lands, from their productivity, etc. On the territory of the farm, the traditional low-cost driving method of keeping horses of the Yakut breed was used.

Mares are milked manually from the left side with all or three fingers, without pulling the nipples, and subjecting them to a kind of clamps. Before milking and during the pause period, the udder massage is performed, which consists in lightly touching and lifting the nipples, which resembles the movement of the foal's lips.

Milking mares are kept next to the horse farm, so they let the stallions go separately with other mares that are not milked. Milking mares are kept in a specially fenced place, foals are also near them and in their free time from milking, they can eat their mother's milk. Milking is carried out in a special split, where the horses enter in turn one by one, for the convenience of the milker, the back leg of the horse can be tied, so that the horse does not kick and stands calmly during milking. During the winter period, mares were constantly kept at the horse farm.

Results

The feeding rations of mares without fertilizing with hay are presented in Tables 1 and 2.

Table 1. The main economic ration of milking mares

Indicators	Unit of measurement	Summer main ration		Winter main ration	
		Norm	Nutrients, actual amount	Norm	Nutrients, actual amount
Pasture	kg	-	-	21.0	25.0
Meadow grass	kg	25.0	35.0	-	-
Oats	kg	3.5	3.5	3.0	3.0
Salt	g	31.0	31.0	31.0	31.0
Dry matter	kg	11.58	14.70	13.0	13.8
Energy feed units	EFU	10.75	13.70	10.75	11.6
Exchange energy	MJ	107.5	137.0	107.5	116.0
Whole protein	g	1612.5	1778.0	1612.5	1743.3
Digestible protein	g	1122.3	1155.0	1122.3	1274.2
Crude fiber	g	2322.0	3174.0	2322.0	2411.0
Calcium	g	64.5	72.4	64.5	62.3
Phosphorus	g	45.2	39.5	45.2	43.2
Magnesium	mg	17.0	16.2	17.0	16.0
Ferrum	mg	1032.0	998.0	1032.0	968.0
Copper	mg	116.0	119.0	116.0	112.0
Zinc	mg	387.0	389.0	387.0	373.0
Cobalt	mg	5.4	5.6	5.4	5.0
Manganese	mg	516.0	522.0	516.0	498.0
Iodine	mg	5.2	5.3	5.2	4.9
Carotene	mg	290.0	1054.0	290.0	282.0
Feed availability	%	100.0	127.4	100.0	108.0
Calcium: Phosphorus				1:1	1.4:1
Ratio of digestible protein, g/EFU	g/EFU	80-90 g/EFU	84.3 g/EFU	90 g/EFU	109.8 g/EFU

Grass plants of natural meadows are considered to be the foot food of horses. In winter, free grazing horses consume an impressive amount of foot feed, which directly affects the efficiency and profitability of horse production. In the summer, the mares were in the pasture. The technology of keeping mares provided for the maximum use of pastures for high milk yield.

The study of animal diets showed that all the main parameters and indicators of feeding were within the norms of feeding and generally satisfied the animal's nutritional needs. The feed consumption of experimental mares is presented in Table 2.

Table 2. Annual feed and nutrient requirement (per 1 head per year)

Indicators	Average daily feed mass, kg	Period duration, days	Required amount for the feeding period, kg	Contained in feed		
				EFU	Exchange energy, MJ	Digestible protein, kg
Meadow hay	13.0	120	15.60	1076.4	10764.0	71.7
Pasture	25.0	120	30.00	960.0	9600.0	126.0
Meadow grass	35.0	125	43.75	1268.75	12687.5	87.5

Oats	3.8	365	13.87	1276.04	12760.4	149.8
Salt, g	31	365	11.3	-		
Total:				4581.2	45812.0	435.0
Nutrition Required				3923.75	39237.5	408.0
Feed availability				127.8	-	-
Ratio of digestible protein, g/EFU			80-90 g/EFU			95 g/EFU

Keeping of one milking mare needs 4,581.2 EFU. Feed consumption over the periods of the year for the maintenance of experimental mares met the needs of animals in terms of feeding. Over the entire period of keeping mares spent: digestible protein - 435.0 kg, exchange energy amounted to 45812.0 MJ.

Thus, analysis of milking mare feeding showed that the actual feeding of animals was satisfactory.

As a feed additive, there were used the Hongurin's zeolite, extracted in the territory of the Suntarskiy region. Hongurin contains: SiO₂ - 65,11%, Al₂O₃ - 12,16%, Fe₂O₃ - 1,08%, CaO - 2,62%, MgO - 1,88%, K₂O + Na₂O - 3,3%, TiO₂ - 0,13%, H₂O⁺ - 8,89%, H₂O⁻ - 4,26% and other elements - 0.57%. Another component of the feed additive is Sapropel. The chemical composition of which is presented in Table 3.

Table 3. Chemical composition of Sapropel

Composition	Unit of measurement	Indicators
Initial moisture	%	23,06
Alkalinity	mg/100 g	0,57
Chlorides	mg/100 g	0,59
Phosphorus	mg/kg	116,46
Potassium	mg/kg	614,65
Nitrogen, Total	%	0,45
Manganese	mg/kg	6,61
Copper	mg/kg	194,30
Zinc	mg/kg	435,60
Ferrum	mg/kg	370,50
Cobalt	mg/100 g	78,12
Iodine	mg/100 g	1,60
Selenium	mg/kg	67,77
Molybdenum	mg/kg	31,80

Thus, the analysis of Sapropel showed that it contains mineral substances that are deficient in plant foods.

As a result of studies, a certain effect of Zeolite-Sapropel feed additives on the quality indicators of milk productivity of milking mares was established.

Organoleptic evaluation of mare's milk was carried out according to the generally accepted methodology. Evaluation of milk was carried out on such indicators as appearance, texture, taste and smell. Assessment of milk quality is presented in Table 4.

Table 4. Assessment of mare's milk quality ($M \pm m$, $n = 3$)

Group (samples)	Quality indicators			
	appearance	consistency	taste	smell
I - control	homogeneous throughout the mass, without cake and flakes	homogeneous, liquid	typical for milk without extraneous flavors	pleasant, with a pronounced milky-sweet flavor
II - experimental	homogeneous throughout the mass, without cake and flakes	homogeneous, liquid	typical for milk without extraneous flavors	pleasant, with a pronounced milky-sweet flavor
III - experimental	homogeneous throughout the mass, without cake and flakes	homogeneous, liquid	typical for milk without extraneous flavors	pleasant, with a pronounced milky-sweet flavor

The research data showed that mare's organoleptic indicators present no differences in milk groups.

The amount and physico-chemical indicators of milk received are the main parameters that determine the milk productivity of animals. But at the same time, an assessment of the vitamin milk composition is important. The results of studies of the vitamin milk composition showed the difference between the groups (Table 5).

Table 5. Vitamin composition of milk of experimental mares, mg/l

Group	Vitamin A	Vitamin C	Vitamin B1	Vitamin B2	Vitamin B6	Vitamin B12
I - control	0.47 ± 0.01	98.04 ± 0.59	0.32 ± 0.00	0.42 ± 0.00	0.031 ± 0.001	0.0026 ± 0.0001
II - experimental	0.48 ± 0.01	99.85 ± 0.61	0.33 ± 0.01	0.43 ± 0.01	0.033 ± 0.001	0.0027 ± 0.0001
III - experimental	0.49 ± 0.01	100.39 ± 0.26	0.34 ± 0.01	0.46 ± 0.00	0.034 ± 0.001	0.0029 ± 0.0000

Mares of the II and III experimental groups exceeded the control group by 2.13-4.26% ($P > 0.05$), respectively, in the content of vitamin A in their milk. In terms of vitamin C content, the control group lost 1.8% and 2.4% to the II and III experimental groups ($P > 0.05$). Moreover, the mare's milk of the III experimental group had a higher indicator in terms of the content of vitamin A and C than the II experimental group by 0.49% and 0.59% ($P > 0.05$), respectively.

The group B (B1, B2, B6, B12) vitamin content in the milk of mares of the control group was less than in the milk of the II experimental group by 3.13%, 2.38, 6.45% and 3.85% ($P > 0.05$), and less than in the III experimental group by 6.25%, 9.52%, 9.68% and 11.54% ($P > 0.05$), respectively.

When comparing between the experimental groups in terms of the content of vitamin B (B1, B2, B6, B12), the superiority of the II experimental group over the I one was found to be 3.03%, 6.98%, 3.03% and 7.41%, respectively ($P > 0.05$).

As a result of the studies, a certain effect of the Zeolite-Sapropel feed additive on the qualitative indicators of milk productivity of milking mares was established; due to the inclusion of Zeolite-Sapropel feed additives, it improves the mineral nutrition of mares, which affected the quality of the products obtained.

Conclusion

Evaluation of the vitamin composition of Koumyss found that the experimental groups had the highest indicators than in the control group. There were differences in the content of vitamins in Koumyss in all groups. The content of vitamin A in the experimental groups was higher by 19.5% and 25.8%. The content of vitamin C in Koumyss in the experimental groups was higher by 2.3% and 4.4%. At the same time, the group of vitamins B had a similar trend, in the experimental groups there were more B1 by 14.2% and 19.0%, B2-25.0% and 50.0%, B6-6.0% and 9.0%, B12-5.8% and 9.3%, respectively. This proves that the use of Zeolite-Sapropel feed additives in the feeding of dairy mares also affects the quality of dairy horse breeding products.

The conducted organoleptic evaluation of Koumyss showed that there were no differences in the criteria for evaluating the appearance, taste, smell, consistency and color. This means that the use of Zeolite-Sapropel feed additives in feeding mares does not affect the quality of dairy products.

As a result of studies, it was found that the use of Zeolite-Sapropel feed additives in the diets of mares of the Megezhsky breed did not adversely affect the quality indicators of milk productivity of milking mares.

It was found that when using Zeolite-Sapropel feed additives in the diets of mares, there was a tendency to a change in the vitamin composition of milk towards an increase in the concentration of vitamins A, C, B1, B2, B6 and B12.

Thus, zeolite and Zeolite-Sapropel feed additives in the diet of dairy mares of the megezhsk breed increase their milk productivity, improve product quality, and increase the efficiency of dairy horse breeding.

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